URC UAV

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University Rover Challenge

Annual international competition at the Mars Desert Research Station in Utah. The goal is to build a next generation system that can eventually assist human exploration on Mars.

Competition Events:

- Astronaut Assistance Task
- Equipment Servicing Task
- Sample Return Task
- Terrain Traversal Task

URC UAV Purpose

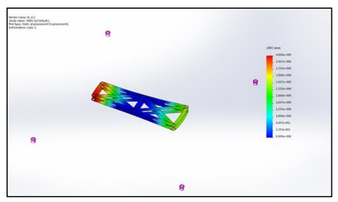
The UAV will provide aerial assistance for Team Olympus throughout the Mars Society 2015 University Rover Challenge. Assistance includes carrying tools, identifying optimal travel path, and locating objects. This project will be the first active UAV ever used in the competition.

Structures

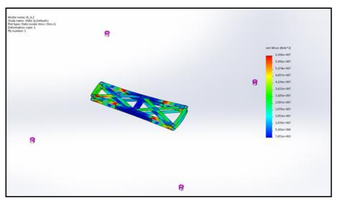
Main Components:

- Central Composite Truss Structure
- Four Unidirectional Carbon Fiber Arms
- Four 30-inch propellers
- Al 6061 Motor Mounts and Swivel Mounts

For analysis on the central truss structure, a 120 N remote force was applied at the end of each arm and scoped to the connection point. This simulates the maximum thrust produced by each 30 inch propeller and Turnigy Multistar Motor.



Total Deformation



Von-Mises Stress

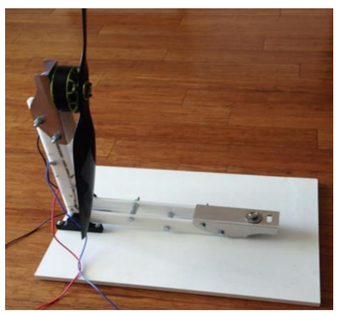
The structure uses unidirectional inter-modulus 7 (IM7), which has a yield strength of 3000 MPa. Use of unidirectional allowed the fibers to be placed in the exact orientation needed to increase the strength to weight ratio.

The molds for the composite pieces were CNC'd out of starboard. The carbon fiber was laid using the wet lay up process which entails mixing and applying epoxy to the fibers and using a vacuum to ensure the they conformed to the right shape during the curing process.

System Overview

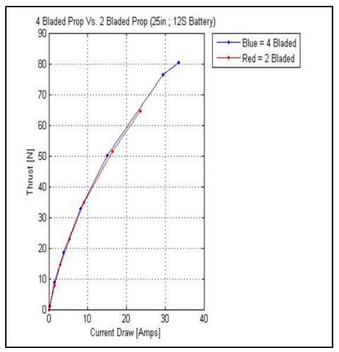
- Primary Weight: 11.1 kg
- Deadweight (URC required): 5.06 kg
- Total Weight: 16.16 kg
- Full Structure Length: 2.05 m
- Max Flight Time w/ Deadweight: 31 minutes
- Max Flight Time w/o Deadweight: 1 hour

Propeller and Motor Testing



Created a thrust stand for testing of different motor, propeller and battery supply configurations.

- Thrust stand modeled so the moment arm between the center of thrust and the pivot point was the same as between the scale and the pivot point
- Components used were cnc'd delrin side brackets and aluminum mounting brackets



Testing provided Thrust vs. Amps curves for each configuration in order to find optimum set up for UAV to lift the heaviest payload while not sacrificing flight time.

Tests Included:

- 4 bladed and 2 bladed configurations using 22, 25 and 30 inch propellers
- 100 KV and 160 KV motors
- 22.2V, 29.6,37V and 44.4V batteries

Electronics

Video Transmission

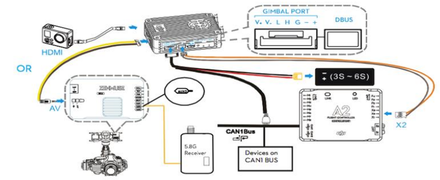
- 2.4 Ghz HD Digital Video Downlink System
  - Overall range: Approx. 1.7 km using omnidirectional antennas
  - 2 cameras will be utilized:
    - One fixed for first person view (FPV) flight
    - One will be attached to a 3 axis gyroscopic gimbal.

Commercial Flight Controller

- Naza Wookong M
  - Stand alone Inertial Mass Unit and Gps System
  - Position Accuracy - Vertical: ± 0.5m, Horizontal: ± 2m

Power Source

- 2 6S Tattu 22,000 mah Batteries
  - Batteries in series to bring total system voltage to 44.4 V



Astronaut Assistance Task

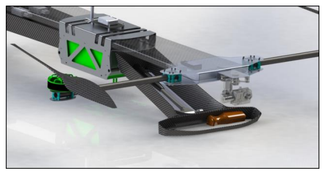
Tools must be collected by Rover and delivered to designated astronaut drop zone. May be up to four drop zones at 1 km away from start gate. UAV will deliver tools to minimize time and thus maximize points for the task.

Task Requirements:

- Collect tools from Rover
- Carry four tools simultaneously
- Deliver within 1 meter radius of target
- Drop each tool individually
- Minimize total distance traveled

5.2 km Optimal Path

Tool Holders:



Previous concept failed due to inefficiency in placing tools in the more concealed holders as well as complexity in dropping each tool individually.

Final design provides easy loading access into two holder variations. Holders are then dropped individually utilizing an E-Flite Servoless Payload Release EFLA405.